AEC-NASA TECH BRIEF

An Investigation of Particle Mixing in a Gas-Fluidized Bed

An experimental investigation of the movement of particles in a fluidized bed has been conducted by R. E. Carlson of Argonne National Laboratory, Argonne, Illinois. A paper, "An Investigation of the Mechanism of Particle Mixing in a Gas-Fluidized Bed," is available which comprehensively discusses the theories behind the work, previous studies, experimental techniques, and results of the investigation. The work was conducted in support of a theory by John D. Gabor, also of Argonne. Previously used experimental techniques were extended to determine the effect of particle size and column diameter.

A major problem with the use of fluidized beds is the lack of understanding of how particles circulate in the bed. A clearer picture of the mechanism for particle movement should aid in the development of more universal correlations for heat and mass transfer.

Thus, in the present investigation, the mechanism for particle movement in gas-fluidized beds is studied both from the theoretical and experimental points of view.

Gabor's theory, which is based on the stream function for an ideal fluid describes particle trajectories and drift profiles for the case of a bubble rising midway between parallel walls.

In order to test Gabor's theory, a "two-dimensional" fluidized bed was used to observe how particles in the interior of a fluidized bed move when a bubble passes through. This bed consisted of a parallelepiped whose thickness was small compared to its length and width. This method approximated a thin vertical slice from the center of a cylindrical bed.

Two columns were used. The front and back plates were made of pyrex glass, coated on the sides facing the beds with a mixture of antimony and tin oxides. This coating conducts away static charges which build up at the walls from friction of the glass heads used as bed material. Besides the glass beads, black particles of the same size were used in each experiment as tracers. Actual height of fluidized material in the bed was 10"

The bed was fluidized by nitrogen from a sintered brass porous distributor plate. While air flow was kept at that for incipient fluidization (such that few or no bubbles formed), an additional burst of nitrogen was introduced through an orifice in the distributor plate. Bubbles introduced in this way could be controlled at the desired size and frequency by a solenoid valve and a two-cycle timer.

By photographing the bed as a bubble passed through, the particle trajectories could be determined. High speed motion pictures were taken with a Fastax camera operating at 400 f.p.s. with Ektachrome film. The film was then analyzed frame by frame with a Vanguard Motion Analyzer.

The net displacements caused by the trajectories were plotted versus distance from the wall to obtain drift profiles.

Notes:

1. This information is an advance in the understanding of fluidized beds which may permit scale-up of models.
2. Since fluidized beds are used in the catalytic cracking of petroleum, the calcination of limestone, the roasting of ores, cement manufacture, drying of solids, vapor disposition, etc., the information may be of interest to researchers in these fields.

(continued overleaf)

3. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B68-10407

Source: R. E. Carlson and J. D. Gabor of the Chemical Engineering Division (ARG-10182)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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